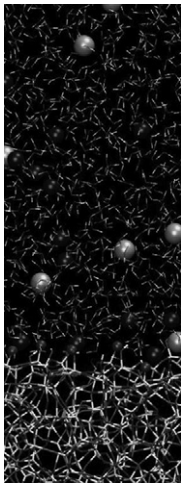
264-Pos Board B143
Engineering the protein-nanoparticle interface
Kimberly Hamad-Schifferli.
MIT, Cambridge, MA, USA.
Nanoparticles have been conjugated to proteins to create unique imaging agents, multifunctional particles, and drug delivery vehicles. However, the biggest barrier for the success of these applications is understanding the interface of biomolecules with nanoparticles. Often conjugation of proteins and DNA with nanoparticles results in protein denaturation and non-specific adsorption, which are due to the many non-covalent interactions at the inorganic-biological interface. While development of new biological applications of nanoparticles has garnered a great deal of attention, the protein-nanoparticle interface has remained poorly characterized. As a result, insufficient understanding of the interface has limited the capabilities of nano-bio hybrids.
We present work in which we study the interface between inorganic nanoparticles of Au and CoFe2O4 and the protein cytochrome c, which is covalently linked to the nanoparticle. We devise a method to site-specifically label the protein, minimizing non-specific adsorption. We study the effect of nanoparticle ligand, nanoparticle material, and protein labeling site on the structure of the protein. Biophysical techniques such as quantitative gel electrophoresis, circular dichroism, and optical spectroscopy are used to characterize the structure of the protein in the conjugate. These experiments allow us to understand the chemical interactions involved in non-specific adsorption, and come up with general design rules for optimal conjugation. We determine that nanoparticle labeling generally destabilizes the motif containing the labeling site, and that when the nanoparticle is labeled on certain motifs, protein denaturation is not recoverable.

265-Pos Board B144
Combining Microfluidics, Electrophysiology, and Fluorescence Detection to Study Drug Transport Across Biomembranes
Kim Horger, Marian Adamson, Divya Rao, Michael Mayer.
University of Michigan, Ann Arbor, MI, USA.
The goal of this project is to develop a chip-based functional assay for studying multi-drug resistance (MDR) transporter proteins. The proposed assay combines electrophysiology with fluorescence spectroscopy on a microfluidic platform to yield new information about MDR transporter functions and their role in cancers. This apparatus and the information gained will facilitate drug screening for molecules that mediate or bypass MDR transporter mechanisms. Here, we highlight the progress made thus far in developing this chip-based assay.

266-Pos Board B145
A Realistic Model For The Water-amorphous Silica Interface: Insights Into The Electrical Double Layer And Bioengineering Applications
Ali Hassanali, Hui Zhang, Yun Kyung Shin, Chris Knight, Sherwin J. Singer.
The Ohio State University, Columbus, OH, USA.
The physical and chemical properties of the amorphous silica-water interface are crucial for fundamental understanding of electrical double layer and electrokinetic phenomena, and for various applications including chromatography, sensors, metal ion extraction, and the construction of micro- and nanoscale devices for biomedical applications. The model reported here, which includes both dissociated and undissociated silanol groups on the surface, is a step toward a practical microscopic model of this important system. Our calculated value for the heat of immersion, 0.3Jm-2, falls within the range of reported experimental values (0.2-0.8Jm-2). The silica surface is characterized by hydrophilic and hydrophobic regions, depending on the statistical variations in silanol group density. This, and other properties, have been successfully benchmarked against ab initio MD simulations. We report structural and dynamical properties of the electrical double layer for various ionic strengths, testing venerable theories like the Gouy-Chapman-Stern model. We are extending our model to allow simulation of proteins, nucleic acids and other polymers near the surface.



267-Pos Board B146
1-d Lipid Bilayers On Nanotube And Nanowire Templates: Properties And Device Applications
Nipun Misra[1,2], Julio Martinez[2,3], Shih-Chie Jay Huang[2,4], Pieter Stroeve[3], J. Woody Ju[4], Costas Grigoropoulos[1], **Aleksandr Noy[2]**.
[1]UC Berkeley, Berkeley, CA, USA, [2]Lawrence Livermore National Laboratory, Livermore, CA, USA, [3]UC Davis, Davis, CA, USA, [4]UCLA, Los Angeles, CA, USA.
One-dimensional nanomaterials present an exciting opportunity for creating functional biologically-inspired structures because they have unique materials properties, dimensions comparable with the typical size of biological assemblies or individual molecules, and geometry suitable for integration into functional devices and assemblies. We have integrated carbon nanotubes and silicon nanowires with phospholipid bilayers in a ''one-dimensional lipid bilayer'' assembly in which a nanowire or a nanotube is shielded by a continuous fluid lipid membrane. We will discuss the structure and properties of this bio/nanomaterial assembly, as well as its electrochemical characterization and application in bio/nanoelectronic devices utilizing functional membrane proteins.

268-Pos Board B147
Examining the Role of Neuregulin-1 in Synaptogenesis Using Microfluidics
Aileen J. Wu[1], Samir Koirala[2], Gabriel Corfas[2], Albert Folch[1].
[1]University of Washington, Seattle, WA, USA, [2]Children's Hospital Boston; Harvard Medical School, Boston, MA, USA.
Determining the molecular mechanisms behind synaptogenesis (synapse formation and maintenance) is of great importance for understanding higher brain function as well as disease states such as Alzheimer's and muscular dystrophy. Neuregulin-1 (NRG-1), a nerve derived protein, was isolated based on its ability to stimulate new acetylcholine receptor (AChR) formation on muscle. This molecule has been hypothesized to enforce the high density of AChRs on the post-synaptic membrane in neuromuscular synapses, however, its role in vivo has been difficult to study due to the early death of NRG and ErbB mutants. Therefore, we have developed a microfluidic system, mimicking a synapse by focally delivering nerve derived proteins to a cell chamber containing myotubes, to study synaptogenesis. Also, the device's focal delivery capacity coupled with patterning of the culture chamber surface allows us to ask questions with spatial variables. As a platform for our AChR kinetics studies, we have examined complex, aneural AChR clusters found on muscle and first reported by Kummer et al. in 2004. These features are good models of in vivo post-synaptic areas, because they have similar topologies, protein expression and developmental patterns. After staining with fluorescent bungarotoxin, we have found that neuregulin decreases the half-life of receptors in pretzels by 21.4%. We have also confirmed that NRG-1 increases receptor insertion into pretzels. Afterwards, we examined the extent NRG-1 activation travels in the long, multi-nucleated muscle cell using mRNA in situ hybridization.

269-Pos Board B148
A Simulation Study of Carbon Nanotube Interactions with Designed Amphiphilic Peptides
E. Jayne Wallace, Robert S.G. D'Rozario, Beatrice Mendoza, Mark S.P. Sansom.
University of Oxford, Oxford, United Kingdom.
There is great interest in exploiting the novel properties of carbon nanotubes (CNTs) for use in biology and medicine. For example, CNTs have potential application in drug delivery, cancer and gene therapy, and as biosensors. However, prior to their usage we need to develop methods to overcome the hydrophobicity-induced aggregation of CNTs. Recently, designed synthetic peptides have proven effective at dispersing CNTs. This approach has the significant advantage that the nature of the peptides coating the CNTs can be controlled by specifying the amino acid sequence. Hence, peptides can be designed such that the peptide/CNT complex may target specific tissue. One such designed synthetic peptide, nano-1,[1] folds into an amphiphilic α-helix in the presence of CNTs and leads to CNT dispersion. Here we implement molecular dynamics to investigate the self-assembly of nano-1 onto CNTs, using both a coarse-grained and atomistic approach. Using this multi-scaled method, we show that nano-1 interacts with CNTs in a preferential orientation. Furthermore, the charged surfaces of nano-1 facilitate inter-peptide interactions within the peptide/CNT complex, promoting helix stability.
[1]. Dieckmann, G.R. *et al.* Controlled assembly of carbon nanotubes by designed amphiphilic peptide helices. *J. Am. Chem. Soc.* **125,** 1770-1777 (2003).

270-Pos Board B149
Interaction of Fullerol C60(OH)20 with Nucleic Acids
Sini Anttalainen[1], Tatsiana Ratnikova[2], Pu-Chun Ke[2], **Emppu Salonen[1]**.
[1]Helsinki University of Technology, Espoo, Finland, [2]Clemson University, Clemson, SC, USA.
Functionalized fullerenes have received much attention during the recent decade in view of their potential use in in vivo imaging, drug transport, and even functioning as the drugs themselves as HIV-1 protease inhibitors, antioxidants, and neuroprotective agents [1]. Yet, the use of functionalized nanoparticles in